

# **EXHIBIT C**



US008431849B2

(12) **United States Patent**  
**Chen**

(10) **Patent No.:** **US 8,431,849 B2**  
(45) **Date of Patent:** **Apr. 30, 2013**

(54) **BACKLIGHTING APPARATUS FOR A  
KEYPAD ASSEMBLY**

(75) Inventor: **Chao Chen**, Waterloo (CA)

(73) Assignee: **Research In Motion Limited**, Waterloo,  
Ontario (CA)

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 95 days.

(21) Appl. No.: **12/889,594**

(22) Filed: **Sep. 24, 2010**

(65) **Prior Publication Data**

US 2012/0073941 A1 Mar. 29, 2012

(51) **Int. Cl.**  
**H01H 13/83** (2006.01)

(52) **U.S. Cl.**  
USPC ..... **200/314**; 200/516; 200/310; 200/313

(58) **Field of Classification Search** ..... 341/22;  
345/168–170; 200/5 A, 516, 310–317, 341  
See application file for complete search history.

(56) **References Cited**

#### U.S. PATENT DOCUMENTS

4,177,501 A	12/1979	Karlin	
7,027,036 B2	4/2006	Yang	
7,064,288 B2 *	6/2006	Nam	200/406
7,223,005 B2	5/2007	Lamb et al.	
7,364,337 B2	4/2008	Park	
7,608,792 B1	10/2009	Tsai	
7,619,173 B2 *	11/2009	Inoue	200/310
7,683,279 B2	3/2010	Kim	
7,888,613 B2 *	2/2011	Jeffery et al.	200/314
7,994,445 B2 *	8/2011	Aihara et al.	200/314
8,143,541 B2 *	3/2012	Tanabe et al.	200/310

2007/0057031 A1	3/2007	Lee	
2007/0242048 A1	10/2007	Yang	
2007/0285947 A1	12/2007	Kim	
2008/0186736 A1	8/2008	Rinko	
2008/0267572 A1	10/2008	Sampsel et al.	
2009/0122016 A1	5/2009	Huang	
2009/0145733 A1 *	6/2009	Tatehata et al.	200/314
2009/0173607 A1	7/2009	Lee et al.	
2009/0283394 A1	11/2009	Masuda	
2010/0108486 A1 *	5/2010	Yoshida	200/520
2010/0133083 A1 *	6/2010	Watanabe et al.	200/5 R
2010/0148996 A1	6/2010	Wang	
2010/0200381 A1	8/2010	Kuo	
2011/0079497 A1 *	4/2011	Ng et al.	200/314

#### FOREIGN PATENT DOCUMENTS

EP	1729205 A2	12/2006
EP	1901321 A2	3/2008
EP	2063297 A1	5/2009

(Continued)

#### OTHER PUBLICATIONS

Web page. Top Bound USA, "Light Guide Film." Available: <http://topboundusa.com/keypads.html>.

(Continued)

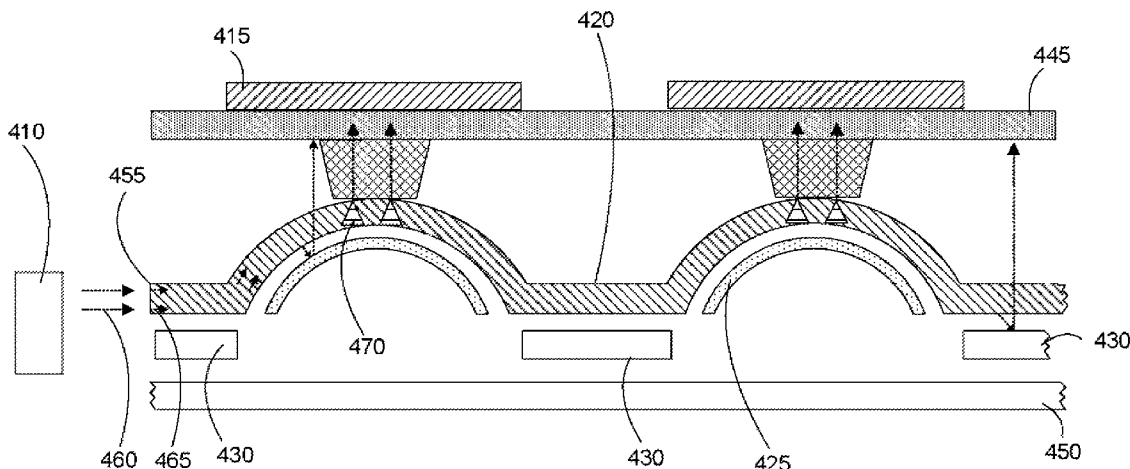
*Primary Examiner* — Michael Friedhofer

(74) *Attorney, Agent, or Firm* — Bereskin and Parr  
LLP/S.E.N.C.R.L., s.r.l.

(57) **ABSTRACT**

A keypad assembly including a dome configured to operatively engage a switch sensor; a dome overlay guide operatively coupled by to the dome; a key corresponding to the dome and configured to operatively engage the dome; and a light emitting source, configured to emit light. The dome overlay guide is configured to receive the light emitted by the light emitting source and direct the received light toward the keys.

**16 Claims, 5 Drawing Sheets**



**US 8,431,849 B2**

Page 2

## FOREIGN PATENT DOCUMENTS

EP	2141716	A1	1/2010
KR	20060120514	A	11/2006
WO	2007102633	A1	9/2007
WO	2009157218	A1	12/2009

## OTHER PUBLICATIONS

Web page. Shin-Etsu, "Shin-Etsu keypad AP-I type." Available: <http://www.shinetsu.co.jp/e/materials/electronics/index.shtml>.

Co-pending U.S. Appl. No. 12/874,269. "Backlighting Assembly for a Keypad," filed Sep. 2, 2010.

Examination Report received on corresponding European Application No. 10179232.3, dated Jan. 18, 2012.

Extended European Search Report (European Application No. 10179232.3) dated Feb. 7, 2011.

Extended European Search Report (European Application No. 10175018.0) dated Feb. 7, 2011.

Web page. Top Bound USA, "Light Guide Film" Available: <http://topboundusa.com/keypads.html>.

Web page. Wikipedia, "Blacklight / Light Guide Plate." Available: [http://en.wikipedia.org/wiki/Light\\_guide\\_plate](http://en.wikipedia.org/wiki/Light_guide_plate).

Web page. Electronicstalk, "Light guide film is ideal for backlighting tasks." Available: <http://www.electronicstalk.com/news/agi/agi488.html>.

Web page. Fujipoly, "Fujipoly Light Guide Film." Available: [http://www.fujipoly.co.jp/english/products/other\\_04/index.htm](http://www.fujipoly.co.jp/english/products/other_04/index.htm).

Second Examination Report received on corresponding European Application No. 10179232.3, dated Jun. 19, 2012.

Response as filed on European Application No. 10179232.3, dated Oct. 19, 2012.

Office Action as issued on copending U.S. Appl. No. 12/874,269, dated Oct. 17, 2012.

Response to Office Action, as submitted on copending U.S. Appl. No. 12/874,269, dated Dec. 14, 2012.

Third Examination Report received on related European Application No. 10179232.3, dated Feb. 27, 2013.

Second Office Action, as issued on copending U.S. Appl. No. 12/874,269, dated Mar. 1, 2013.

\* cited by examiner

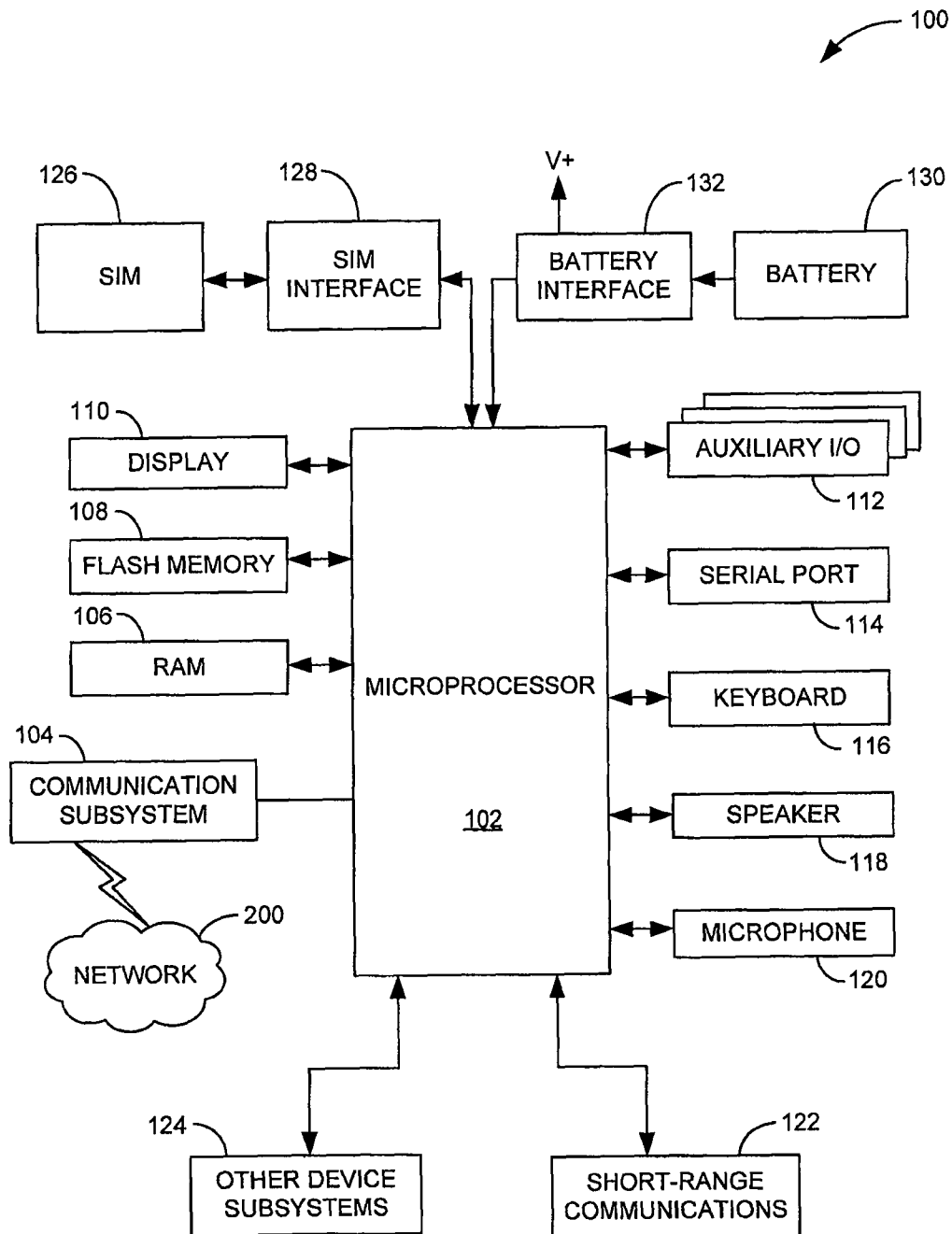
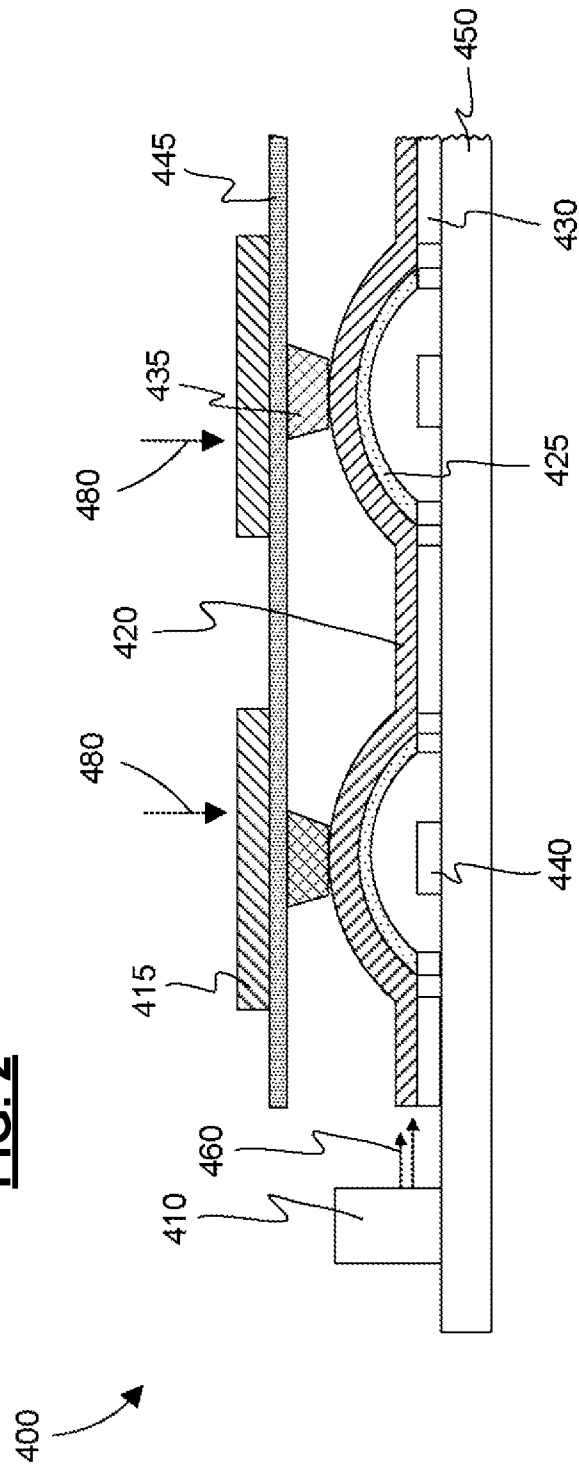
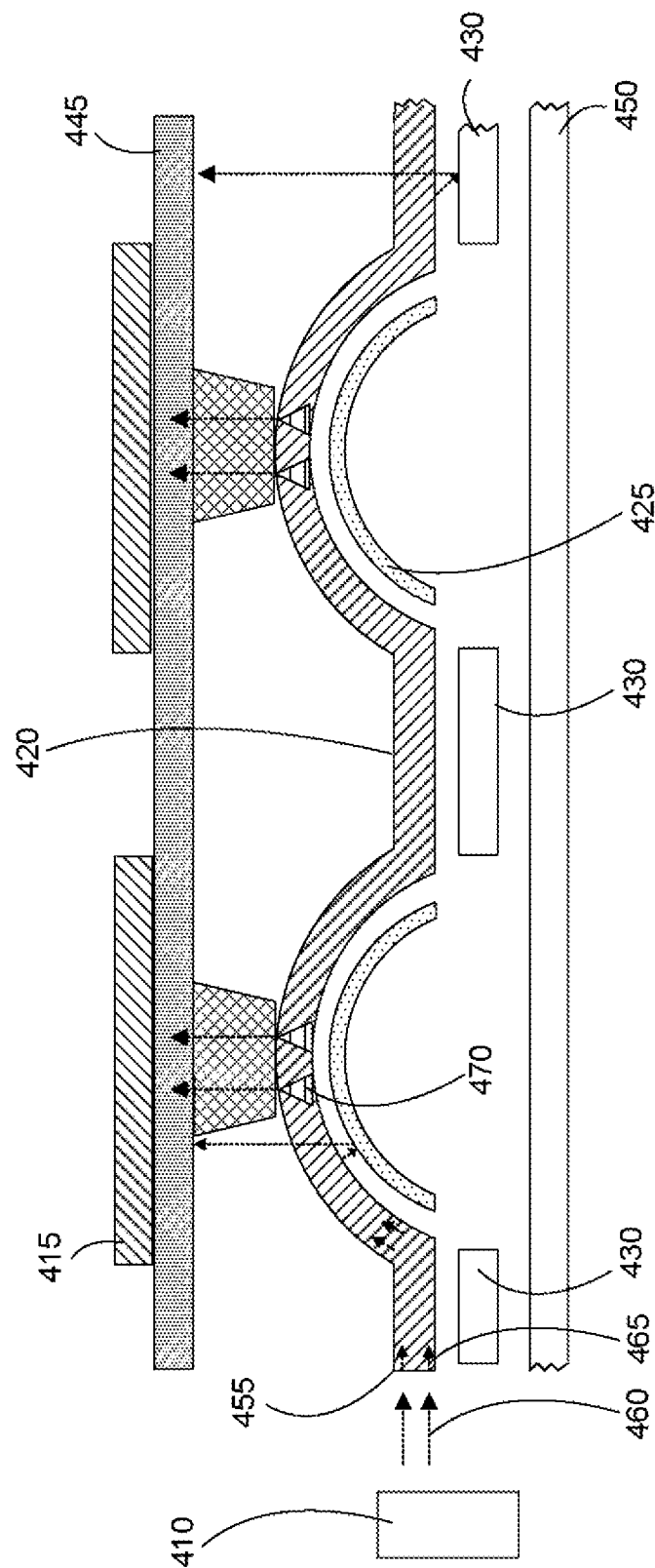


FIG. 1

**FIG. 2**





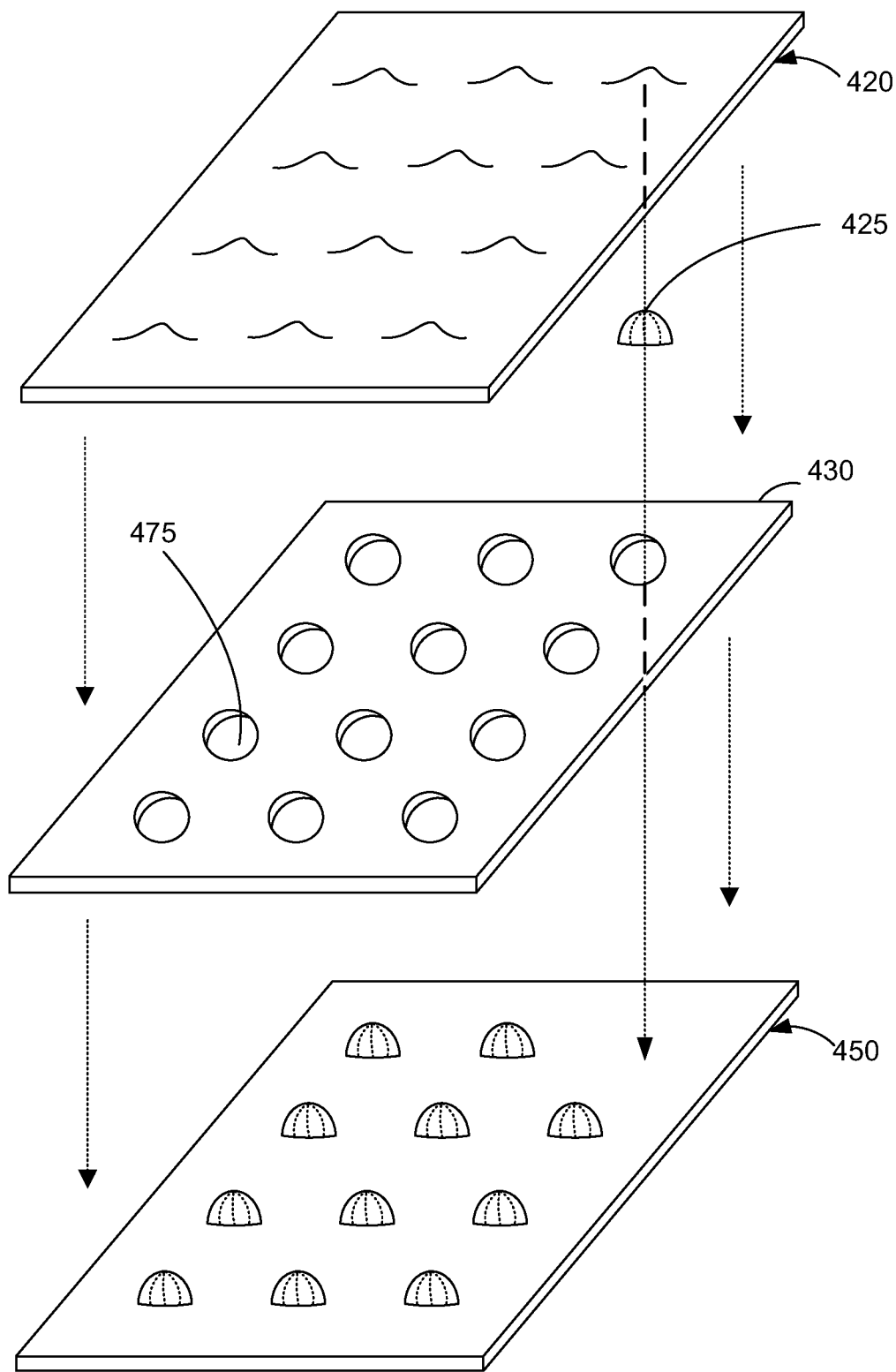
**FIG. 3**

U.S. Patent

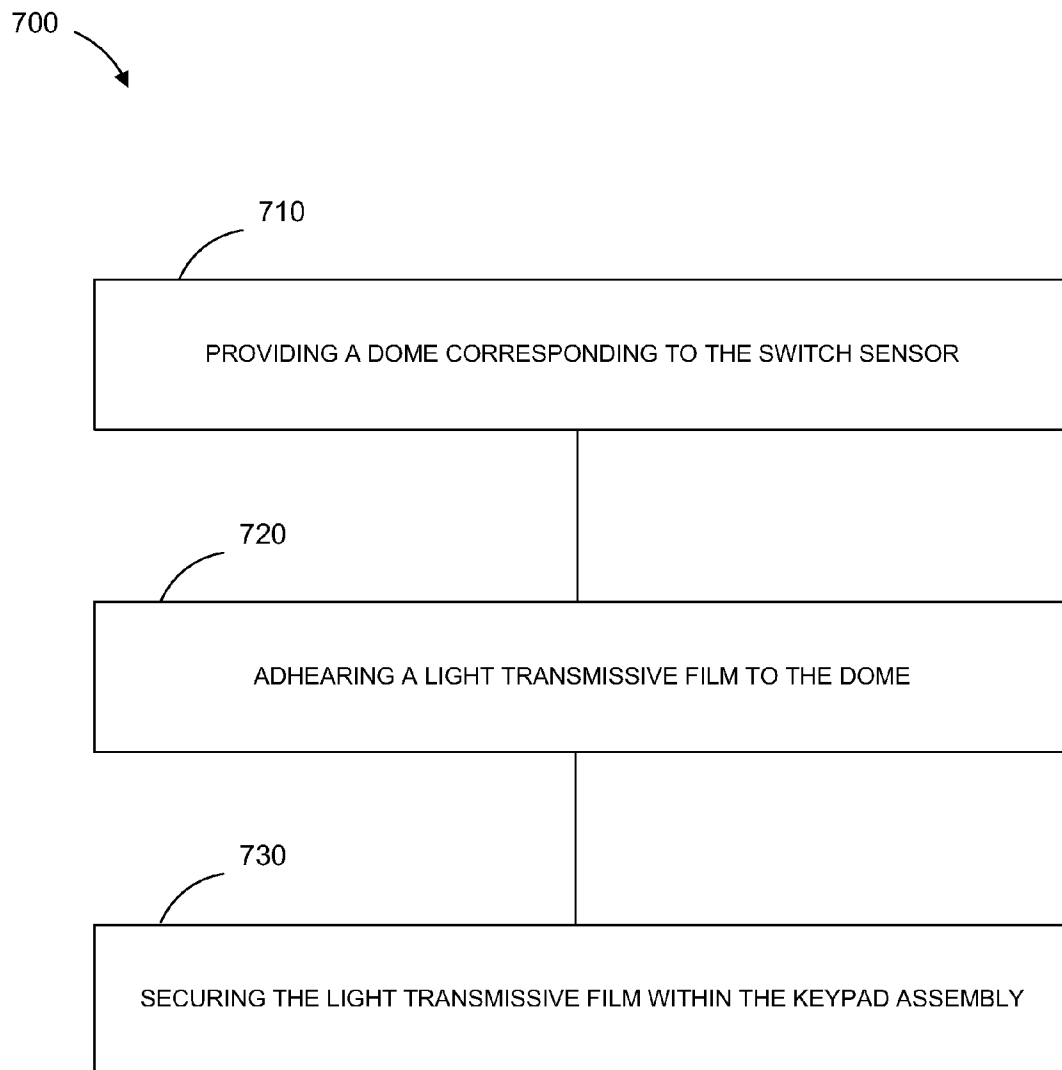
Apr. 30, 2013

Sheet 4 of 5

US 8,431,849 B2



**FIG. 4**



**FIG. 5**



US 8,431,849 B2

1

**BACKLIGHTING APPARATUS FOR A  
KEYPAD ASSEMBLY**

## RELEVANT FIELD

The field of this disclosure relates generally to keypads and keypad backlighting, with particular but by no means exclusive application to keypads of mobile communications devices.

## BACKGROUND

It is often desirable to provide backlighting to the keys of a keypad assembly used in electronic devices such as mobile communications devices during darkened conditions. Light may be emitted from a light source located within the electronic device, and directed toward one or multiple keys illuminating such key(s).

## BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments are described in further detail below, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a block diagram of a mobile device in one example implementation;

FIG. 2 is a section view of a keypad assembly according to an embodiment of the present disclosure;

FIG. 3 is an enlarged section view of selected elements of the keypad assembly of FIG. 2;

FIG. 4 is an exploded perspective view of selected elements of the keypad assembly; and

FIG. 5 is a logical flow diagram of a method for providing backlighting for a keypad assembly according to the present disclosure.

## DETAILED DESCRIPTION

In one broad aspect, there is provided a keypad assembly. The keypad assembly includes a dome configured to operatively engage a switch sensor; a dome overlay guide operatively coupled to the dome; a key corresponding to the dome, and configured to operatively engage the dome; and a light emitting source configured to emit light. The dome overlay guide is configured to receive the emitted light and direct the received light toward the key.

The dome overlay guide may include a light guide film. The keypad assembly may also include a reflector layer configured to reflect light escaping the dome overlay guide. The reflector layer may be configured to reflect the escaping light toward the key. The dome overlay guide may be between the reflector layer and the key.

The operative coupling may include an adhesive. The keypad assembly may also include a deflection web configured to seat the key, wherein the deflection web is between the key and the dome overlay guide.

The light emitting source may include a side firing light emitting diode. The keypad assembly may include a plurality of keys, and a plurality of corresponding domes.

In another broad aspect, there is provided a mobile device comprising the keypad assembly.

In a third broad aspect, there is provided a keypad assembly. The keypad assembly includes a dome configured to operatively engage a switch sensor; a dome overlay guide operatively coupled to the dome; a key corresponding to the dome, and configured to operatively engage the dome; a deflection web configured to seat the key; and a side firing

2

light emitting source configured to emit light. The dome overlay guide is configured to receive the emitted light, and direct the received light toward the key; and an actuator is adjacent a portion of an upper surface of the dome overlay guide.

The dome overlay guide may include a light guide film. The keypad assembly may also include a reflector layer configured to reflect light escaping the dome overlay guide. The reflector layer may be configured to reflect the escaping light toward the key.

The keypad assembly may also include a printed circuit board, wherein the reflector layer is positioned between the printed circuit board and the dome overlay guide. The dome overlay guide may be adhered to the reflector layer.

The dome overlay guide may include at least one cavity configured to emit the received light in a direction toward the key. The side firing light emitting source may include a light emitting diode.

In another broad aspect, there is provided a method for providing backlighting for a keypad assembly, the keypad assembly comprising a printed circuit board having a switch sensor, a key corresponding to the switch sensor, and a light emitting source configured to emit light. The method includes providing a dome corresponding to the switch sensor; adhering a light guide film to the dome; and securing the light guide film within the keypad assembly, wherein the film is configured to receive the emitted light, and wherein the dome is configured to operatively engage the switch sensor.

The method may also include adhering a reflector layer to the light guide film.

Some embodiments of the system and methods described herein make reference to a mobile device. A mobile device may be a two-way communication device with advanced data communication capabilities having the capability to communicate with other computer systems. A mobile device may also include the capability for voice communications. Depending on the functionality provided by a mobile device, it may be referred to as a data messaging device, a two-way pager, a cellular telephone with data messaging capabilities, a wireless Internet appliance, or a data communication device (with or without telephony capabilities), for example. A mobile device may communicate with other devices through a network of transceiver stations.

To aid the reader in understanding the structure of a mobile device, reference is made to FIG. 1.

FIG. 1 is a block diagram of a mobile device in one example implementation, shown generally as **100**. Mobile device **100** comprises a number of components, the controlling component being microprocessor **102**. Microprocessor **102** controls the overall operation of mobile device **100**. Communication functions, including data and voice communications, may be performed through communication subsystem **104**. Communication subsystem **104** may be configured to receive messages from and send messages to a wireless network **200**. In one example implementation of mobile device **100**, communication subsystem **104** may be configured in accordance with the Global System for Mobile Communication (GSM) and General Packet Radio Services (GPRS) standards. The GSM/GPRS wireless network is used worldwide and it is expected that these standards may be supplemented or superseded eventually by Enhanced Data GSM Environment (EDGE) and Universal Mobile Telecommunications Service (UMTS), and Ultra Mobile Broadband (UMB), etc. New standards are still being defined, but it is believed that they will have similarities to the network behaviour described herein, and it will also be understood by persons skilled in the art that the embodiments of the present disclosure are

3

intended to use any other suitable standards that are developed in the future. The wireless link connecting communication subsystem **104** with network **200** represents one or more different Radio Frequency (RF) channels, operating according to defined protocols specified for GSM/GPRS communications. With newer network protocols, these channels are capable of supporting both circuit switched voice communications and packet switched data communications.

Although the wireless network associated with mobile device **100** is a GSM/GPRS wireless network in one example implementation of mobile device **100**, other wireless networks may also be associated with mobile device **100** in variant implementations. Different types of wireless networks that may be employed include, for example, data-centric wireless networks, voice-centric wireless networks, and dual-mode networks that can support both voice and data communications over the same physical base stations. Combined dual-mode networks include, but are not limited to, Code Division Multiple Access (CDMA) or CDMA2000 networks, GSM/GPRS networks (as mentioned above), and future third-generation (3G) networks like EDGE and UMTS. Some older examples of data-centric networks include the Mobitex™ Radio Network and the DataTAC™ Radio Network. Examples of older voice-centric data networks include Personal Communication Systems (PCS) networks like GSM and Time Division Multiple Access (TDMA) systems. Other network communication technologies that may be employed include, for example, Integrated Digital Enhanced Network (iDEN™), Evolution-Data Optimized (EV-DO), and High Speed Packet Access (HSPA), etc.

Microprocessor **102** may also interact with additional subsystems such as a Random Access Memory (RAM) **106**, flash memory **108**, display **110**, auxiliary input/output (I/O) subsystem **112**, serial port **114**, keyboard **116**, speaker **118**, microphone **120**, short-range communications subsystem **122** and other device subsystems **124**.

Some of the subsystems of mobile device **100** perform communication-related functions, whereas other subsystems may provide “resident” or on-device functions. By way of example, display **110** and keyboard **116** may be used for both communication-related functions, such as entering a text message for transmission over network **200**, as well as device-resident functions such as a calculator or task list. Operating system software used by microprocessor **102** is typically stored in a persistent store such as flash memory **108**, which may alternatively be a read-only memory (ROM) or similar storage element (not shown). Those skilled in the art will appreciate that the operating system, specific device applications, or parts thereof, may be temporarily loaded into a volatile store such as RAM **106**.

Mobile device **100** may send and receive communication signals over network **200** after network registration or activation procedures have been completed. Network access may be associated with a subscriber or user of a mobile device **100**. To identify a subscriber, mobile device **100** may provide for a Subscriber Identity Module (“SIM”) card **126** to be inserted in a SIM interface **128** in order to communicate with a network. SIM card **126** may be one example type of a conventional “smart card” used to identify a subscriber of mobile device **100** and to personalize the mobile device **100**, among other things. Without SIM card **126**, mobile device **100** may not be fully operational for communication with network **200**. By inserting SIM card **126** into SIM interface **128**, a subscriber may access all subscribed services. Services may include, without limitation: web browsing and messaging such as e-mail, voice mail, Short Message Service (SMS), and Multimedia Messaging Services (MMS). More advanced

4

services may include, without limitation: point of sale, field service and sales force automation. SIM card **126** may include a processor and memory for storing information. Once SIM card **126** is inserted in SIM interface **128**, it may be coupled to microprocessor **102**. In order to identify the subscriber, SIM card **126** may contain some user parameters such as an International Mobile Subscriber Identity (IMSI). By using SIM card **126**, a subscriber may not necessarily be bound by any single physical mobile device. SIM card **126** may store additional subscriber information for a mobile device as well, including datebook (or calendar) information and recent call information.

Mobile device **100** may be a battery-powered device and may comprise a battery interface **132** for receiving one or more rechargeable batteries **130**. Battery interface **132** may be coupled to a regulator (not shown), which assists battery **130** in providing power V+ to mobile device **100**. Although current technology makes use of a battery, future technologies such as micro fuel cells may provide power to mobile device **100**. In some embodiments, mobile device **100** may be solar-powered.

Microprocessor **102**, in addition to its operating system functions, enables execution of software applications on mobile device **100**. A set of applications that control basic device operations, including data and voice communication applications, may be installed on mobile device **100** during its manufacture. Another application that may be loaded onto mobile device **100** is a personal information manager (PIM). A PIM has functionality to organize and manage data items of interest to a subscriber, such as, but not limited to, e-mail, calendar events, voice mails, appointments, and task items. A PIM application has the ability to send and receive data items via wireless network **200**. PIM data items may be seamlessly integrated, synchronized, and updated via wireless network **200** with the mobile device subscriber’s corresponding data items stored and/or associated with a host computer system. This functionality may create a mirrored host computer on mobile device **100** with respect to such items. This can be particularly advantageous where the host computer system is the mobile device subscriber’s office computer system.

Additional applications may also be loaded onto mobile device **100** through network **200**, auxiliary I/O subsystem **112**, serial port **114**, short-range communications subsystem **122**, or any other suitable subsystem **124**. This flexibility in application installation increases the functionality of mobile device **100** and may provide enhanced on-device functions, communication-related functions, or both. For example, secure communication applications may enable electronic commerce functions and other such financial transactions to be performed using mobile device **100**.

Serial port **114** enables a subscriber to set preferences through an external device or software application and extends the capabilities of mobile device **100** by providing for information or software downloads to mobile device **100** other than through a wireless communication network. The alternate download path may, for example, be used to load an encryption key onto mobile device **100** through a direct and thus reliable and trusted connection to provide secure device communication.

Short-range communications subsystem **122** provides for communication between mobile device **100** and different systems or devices, without the use of network **200**. For example, subsystem **122** may include an infrared device and associated circuits and components for short-range communication. Examples of short range communication include standards

US 8,431,849 B2

5

developed by the Infrared Data Association (IrDA), Bluetooth®, and the 802.11 family of standards (Wi-Fi®) developed by IEEE.

In use, a received signal such as a text message, an e-mail message, or web page download is processed by communication subsystem 104 and input to microprocessor 102. Microprocessor 102 then processes the received signal for output to display 110 or alternatively to auxiliary I/O subsystem 112. A subscriber may also compose data items, such as e-mail messages, for example, using keyboard 116 in conjunction with display 110 and possibly auxiliary I/O subsystem 112. Auxiliary subsystem 112 may include devices such as: a touch screen, mouse, track ball, optical trackpad infrared fingerprint detector, or a roller wheel with dynamic button pressing capability. Keyboard 116 may comprise an alphanumeric keyboard and/or telephone-type keypad, for example. A composed item may be transmitted over network 200 through communication subsystem 104.

For voice communications, the overall operation of mobile device 100 may be substantially similar, except that the received signals may be processed and output to speaker 118, and signals for transmission may be generated by microphone 120. Alternative voice or audio I/O subsystems, such as a voice message recording subsystem, may also be implemented on mobile device 100. Although voice or audio signal output is accomplished primarily through speaker 118, display 110 may also be used to provide additional information such as the identity of a calling party, duration of a voice call, or other voice call related information.

Referring now to FIG. 2, a keypad assembly according to an embodiment is shown generally as 400. The keypad assembly 400 may be used within electronic devices, such as the mobile device 100 described above. For example, the keypad assembly 400 may comprise part of the keyboard 116.

The keypad assembly 400 comprises a plurality of keys (or keycaps) 415 which may be arranged on a deflection web 445. Each of the keys 415 is operatively coupled to at least one switch sensor 440. The switch sensor 440 detects if the corresponding key has been pressed and if so it generates a corresponding signal on a printed circuit board 450.

Separating a key 415 from its corresponding switch sensor 440 may be a corresponding dome 425 that is operatively coupled to the switch sensor 440. The dome 425 may be made of metal or another suitable material (or a combination thereof) and may be configured to collapse and contact the switch sensor 440 when the corresponding key 415 is depressed in the key press direction 480 (i.e. the direction 480 in which a key 415 may be depressed). To this end, the key 415 may be configured to operatively engage the dome 425 via an actuator 435. The actuator 435 may comprise part of and extend from the deflection web 445. Specifically, the actuator 435 may be positioned between the key 415 and the dome 425 and it may transfer the key depression force, onto the dome 425. Persons skilled in the art will understand that the domes 425 and the switch sensors 440 may operate like dome switches known in the art.

The keypad assembly 400 includes a light emitting source 410 configured to emit light for illuminating the keys 415. To distribute the light emitted by the light emitting source 410 (referred to hereinafter as “emitted light” 460) to the plurality of keys 415, a dome overlay guide 420 is provided. The dome overlay guide 420 is configured to receive the emitted light 460 (referred to hereinafter as “received light” 465) and direct the received light toward the keys (FIG. 3). To this end, the dome overlay guide 420 may comprise a light guide film.

The dome overlay guide 420 may also serve to keep the domes 425 aligned with their corresponding switch sensors

6

440. To this end, the dome overlay guide 420 may overlay and be operatively coupled, by adhesive or otherwise, to the domes 425.

Persons skilled in the art will appreciate that the keys 415 may be held in place in any suitable manner. For example, the keys 415 may be adhered (using an adhesive or otherwise) to the deflection web 445. In some embodiments (not shown), one or both of the deflection web 445 and the actuators 435 may be configured to seat the keys 415. In such a “seating” embodiment, the keys 415 and the one or both of the deflection web 445 and the actuators 435 may be provided with complementary male (such as a post) and female (such as a seat) features to permit the keys 415 to sit within the one or both of the deflection web 445 and the actuators 435.

Referring now to FIG. 3, the illumination of the keys 415 by the light emitting source 410 is discussed in more detail. The light emitting source 410 is positioned adjacent and oriented towards an edge 455 of the dome overlay guide 420, such that light 460 emitted from the light emitting source 410 is received by the dome overlay guide 420 through its edge 455.

To redirect the received light 465 out of the dome overlay guide 420 toward the keys 415, the dome overlay guide 420 may be provided with several micro features 470. The micro features 470 may be provided at predetermined locations of the dome overlay guide 420 so as to align with the keys 415. When the received light 465 traveling through the dome overlay guide 420 intersects with a micro feature 470, a portion of the received light 465 is redirected toward the key 415 which is aligned with that micro feature 470.

Persons skilled in the art will understand that the micro features 470 have been illustrated schematically and that any micro features suitable for redirecting received light 465 may be used. For example, the micro features 470 may comprise one or more cavities etched into a surface of the dome overlay guide 420. These cavities may, for example, comprise v-shaped cuts, or white printing dots (or micro dots). In some variants, a two dimensional array of micro features 470 on the surface of the dome overlay guide 420 may be provided to help evenly redirect received light 465 toward the keys 415.

Received light 465 traveling through the dome overlay guide 420 may escape (or leak) from the dome overlay guide 420 toward one or more of the printed circuit board 450 and the domes 425. The escape of light from the dome overlay guide 420 may be most common wherever the dome overlay guide 420 is adhered to another surface using an adhesive. The escape of light caused by the use of an adhesive on the dome overlay guide 420 is sometimes referred to as wet out.

In some embodiments, to recapture at least a portion of the received light 465, which escapes the dome overlay guide 420 toward the domes 425 and the printed circuit board 450, the domes 425 and the printed circuit board 450 may be configured to be sufficiently reflective to reflect such escaped light back toward the keys 415. For example, the domes 425 may be one of polished, provided with a reflective coating (for example, silver plating) or naturally reflective. Similarly, a reflector layer 430 may be provided between the dome overlay guide 420 and the printed circuit board 450. The reflector layer 430 may be configured to reflect escaping light back toward the keys 415. The side of the reflector layer 430, which faces the dome overlay guide 420, may be provided with a reflective coating or may be naturally reflective. In some embodiments, the reflector layer 430 may comprise a polymeric specular reflector film, such as for example Vikuiti™ Enhanced Specular Reflector film, as distributed by 3M Optical Systems.



US 8,431,849 B2

7

The deflection web **445** and the actuators **435** may be made from a substantially translucent (or semitransparent) material. This may permit a relatively high portion of light emitted from the dome overlay guide **420** to pass through the deflection web **445** and the actuators **435** and reach the key(s) **415**.

The light emitting source **410** may comprise a side firing (or side emitting) light emitting diode (LED) as may be known in the art. Persons skilled in the art will understand that a side firing LED typically comprises a housing for the LED that is mountable at a base of the housing and an LED configured to emit light from a side wall—adjacent the base—of the housing. In contrast, the housing of a top firing LED, which is also mountable at its base, contains an LED configured to emit light from a top surface—opposite the base—of the housing.

Persons skilled in the art will appreciate that LEDs typically require there to be a certain amount of clearance (or space) between the surface of the LEDs, from which the light is emitted, and a light guide or other object in order for the LEDs to function efficiently. This space is typically referred to as the LED leading space gap. When using side firing LEDs (i.e. LEDs which emit light in a direction that is generally perpendicular to the key press direction **480**), as opposed to top firing LEDs (i.e. LEDs which emit light in a direction that is generally parallel to the key press direction **480**), as the light emitting source **410** within a keypad assembly **400**, any required leading space gap is lateral (i.e. generally perpendicular to the key press direction **480**) rather than vertical (i.e. generally parallel to the key press direction **480**). Consequently, the thickness of the keypad assembly **400** may be reduced by using side firing LEDs instead of top firing LEDs as the light emitting source **410** within a keypad assembly **400**.

Referring now to FIG. **4**, the alignment and configuration of the reflector layer **430** is discussed in greater detail. FIG. **4** shows an exploded view of the dome overlay guide **420**, the reflector layer **430**, and the printed circuit board **450** with the domes **425**. The reflector layer **430** is provided with apertures **475**, each of which corresponds to a dome **425**. Specifically, when the reflector layer **430** is coupled to the printed circuit board **450**, by adhesive or otherwise, the domes **425** each project out of their corresponding aperture **475**. Further, when the dome overlay guide **420** is coupled to the domes **425**, those areas of the dome overlay guide **420** that are not coupled to the domes **425** may be optionally adhered to the reflector layer **430**.

Persons having ordinary skill in the art will understand that the reflector layer **430** may comprise any number and arrangement of apertures **475**. Similarly the keypad assembly **400** may comprise any number and arrangement of keys **415**. For example, FIG. **4** shows an example reflector layer **430** with twelve apertures **475** for use with a standard alphanumeric twelve-key keypad assembly (0-9, #, \*). Those of ordinary skill the art will appreciate that other configurations of the reflector layer **430** and keys **415** may also exist to correspond to keypad assemblies with different numbers and/or arrangements of keys (e.g. a full QWERTY keypad assembly).

Referring now to the logical flow diagram of FIG. **5**, a method (referred to generally as **700**) for providing backlighting for a keypad assembly **400** comprising a printed circuit board **450** having a switch sensor **440**, a key **415** corresponding to the switch sensor **440** and a light emitting source **410** will now be discussed. A dome **425** corresponding to the switch sensor **440**, is provided at Block **710**. The dome **425** is

8

configured to operatively engage the switch sensor **440** when the key **415** corresponding to the switch sensor **440** is depressed.

At Block **720**, a dome overlay guide **420** is adhered or otherwise coupled to the dome **425**. The dome overlay guide **420** may comprise a light transmissive film such as a light guide film and be configured to receive light emitted (or emitted light **460**) from the light emitting source(s) **410** and direct light **460** toward the key(s) **415** of the keypad assembly **400**.

At Block **730**, the dome overlay guide **420** is secured within the keypad assembly. The dome overlay guide **420** may be secured to the printed circuit board **450** by adhering or otherwise coupling the dome overlay guide **420** to the reflector layer **430** which in turn may be adhered or otherwise coupled to the printed circuit board **450**.

In some instances, a keyboard assembly as described herein may be thinner than keyboard assemblies of alternate design, for example designs comprising separate (e.g. laminate) dome overlay guides and light guiding means.

The steps of a method in accordance with any of the embodiments described herein may not be required to be performed in any particular order, whether or not such steps are described in the claims or otherwise in numbered or lettered paragraphs.

The keypad assembly has been described with regard to a number of embodiments. However, it will be understood by persons skilled in the art that other variants and modifications may be made without departing from the scope of the disclosure as defined in the claims appended hereto.

The invention claimed is:

1. A keypad assembly comprising:

- a) a dome configured to operatively engage a switch sensor;
- b) a dome overlay guide adhered to the dome;
- c) a key corresponding to the dome, and configured to operatively engage the dome;
- d) a light emitting source configured to emit light;
- e) a reflector layer configured to reflect light escaping the dome overlay guide;
- f) wherein the dome overlay guide is configured to receive the emitted light and direct the received light toward the key.

2. The keypad assembly of claim 1, wherein the dome overlay guide comprises a light guide film.

3. The keypad assembly of claim 1, wherein the reflector layer is configured to reflect the escaping light toward the key.

4. The keypad assembly of claim 1, wherein the dome overlay guide is between the reflector layer and the key.

5. The keypad assembly of claim 1, further comprising a deflection web configured to seat the key, wherein the deflection web is between the key and the dome overlay guide.

6. The keypad assembly of claim 1, wherein the light emitting source comprises a side firing light emitting diode.

7. The keypad assembly of claim 1, comprising a plurality of keys, and a plurality of corresponding domes.

8. A mobile device comprising the keypad assembly of claim 1.

9. A keypad assembly comprising:

- a) a dome configured to operatively engage a switch sensor;
- b) a dome overlay guide adhered to the dome;
- c) a key corresponding to the dome, and configured to operatively engage the dome;
- d) a deflection web configured to seat the key;
- e) a side firing light emitting source configured to emit light;

## US 8,431,849 B2

9

- f) wherein the dome overlay guide is configured to receive the emitted light, and direct the received light toward the key;
- g) a reflector layer configured to reflect light escaping the dome overlay guide; and
- h) wherein an actuator is adjacent to a portion of an upper surface of the dome overlay guide.

10. The keypad assembly of claim 9, wherein the dome overlay guide comprises a light guide film.

11. The keypad assembly of claim 9, wherein the reflector layer is configured to reflect the escaping light toward the key.

12. The keypad assembly of claim 9, further comprising a printed circuit board, wherein the reflector layer is positioned between the printed circuit board and the dome overlay guide.

13. The keypad assembly of claim 9, wherein the dome overlay guide is adhered to the reflector layer.

10

14. The keypad assembly of claim 13, wherein the dome overlay guide comprises at least one cavity configured to emit the received light in a direction toward the key.

15. The keypad assembly of claim 9, wherein the side firing light emitting source comprises a light emitting diode.

16. A method for providing backlighting for a keypad assembly, the keypad assembly comprising a printed circuit board having a switch sensor, a key corresponding to the switch sensor, a light emitting source configured to emit light, the method comprising:

- a) providing a dome corresponding to the switch sensor;
- b) adhering a light guide film to the dome; and
- c) securing the light guide film within the keypad assembly, wherein the light guide film is configured to receive the emitted light, and wherein the dome is configured to operatively engage the switch sensor; and
- d) adhering a reflector layer to the light guide film.

\* \* \* \* \*